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研究论文

高比表面积 $CuPc/TiO_2$ 纳米管复合材料的制备及其可见光光催化活性

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- 摘要
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摘要 以 P25 为前驱体, 在碱性条件下采用水热法制备了 TiO_2 纳米管 (NT), 然后通过浸渍法将敏化剂酞菁铜 (CuPc) 附着于 TiO_2NT 表面, 制得可见光响应的 $CuPc/TiO_2$NT 复合光催化材料, 并对其进行了表征, 考察了它在可见光下降解罗丹明 B 的光催化活性. 结果表明, 在 NaOH 碱性条件下水热法制备的 TiO_2NT 具有较大的比表面积 (362.6 m^2/g) 和高孔容 (2.039 cm^3/g), 经 0.2%CuPc 修饰后, 复合材料仍然保持较高的比表面积 (244.2 m^2/g) 和孔容 (1.024 cm^3/g), 进而提高了 CuPc 与 TiO_2 界面的光生电荷转移速率, 使光生电子-空穴能够在此界面上形成有效分离, 从而明显提高了复合材料的光催化活性. 在可见光辐照下, 0.2%$CuPc/TiO_2$NT 复合材料的光催化性能最好, 反应 180 min 时, 罗丹明 B 的降解率可达 59%, 比 TiO_2NT 的提高了 3.3 倍.

关键词: 二氧化钛 纳米管 酞菁铜 染料敏化 可见光 罗丹明 B

Abstract: TiO_2-based nanotubes (TiO_2NT) were synthesized by hydrothermal treatment under the alkaline conditions using P25 as the raw material. Then copper phthalocyanine (CuPc) was chosen as a sensitizer to prepare CuPc modified TiO_2NT composite material ($CuPc/TiO_2$NT) by the immersion method. The structure and properties of the samples were characterized, and the photocatalytic activity of pure TiO_2NT and $CuPc/TiO_2$NT was also evaluated by degradating rhodamine B under the visible light. The results showed that the TiO_2NT had large surface area (362.6 m^2/g) and high pore volume (2.039 cm^3/g). Even after modified by CuPc, the composite material still kept the high surface area (244.2 m^2/g) and pore volume (1.024 cm^3/g) for 0.2%$CuPc/TiO_2$NT. The decrease of recombination of photo-injected electrons is expected to appear attributing to the effective charge separation on the interface of TiO_2NT and CuPc, improving the transfer efficiency of the photo-excited charges under visible light. Furthermore, the catalyst exhibited obvious visible photocatalytic activity after sensitized by CuPc. As the mole percentage of CuPc was 0.2% in the composite, the degradation rate of rhodamine B over 0.2%$CuPc/TiO_2$NT could reach 59%, increasing by 3.3 times compared with pure TiO_2NT after reaction for 180 min.

Keywords: titanium dioxide, nanotube, copper phthalocyanine, sensitizing, visible light, rhodamine B

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